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# Insights into durability and impedance of direct DME HT-PEM fuel cells

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Dimethyl ether (DME) is an emerging renewable fuel and an excellent diesel substitute. It has previously been shown that it is possible to oxidize dimethyl ether directly in an HT-PEM FC with performances close to DMFC at the same conditions [1, 2]. The limitations are connected to the very complex oxidation mechanism of DME and are not very well understood. Most of the studies of the mechanism have been conducted at conditions different from the operational HT-PEM fuel cell, and thus do not necessarily represent the occurring processes. In the presented work electrochemical impedance spectroscopy coupled with anode exhaust analysis by gas chromatography is used to study the direct DME HT PEM FC. Preliminary results suggest that a small degree of internal fuel reforming occurs at 200 °C. Additionally, lifetime of the cells has been investigated and current-voltage characteristics together with impedance studies and post-mortem analysis of the MEA cross-section in an SEM have been employed to identify degradation mechanisms. Since dimethyl ether is a known organic solvent, thinning of the PBI membrane was thought to be one of the main causes for the degradation, but that appeared not to be the case. Instead, formation and growth of pinholes at hotspots was identified as the cause for MEA death.

[1] A. Vassiliev et al., *A direct DME high temperature PEM fuel cell*, ECS Transactions, 2012, 50, 2, p. 869.

[2] J.O. Jensen et al., *Direct dimethyl ether fueling of a high temperature polymer fuel cell*, Journal of Power Sources, 2012, 211, p. 173.